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BARRIERS TO PEST INVASION

Field of the Invention

The present invention relates to physical pest barriers and, in particular, to physical pest barriers and methods for preventing or reducing pest invasion of a building or structure in the area surrounding a utility penetration. The present invention has particular application to shielding the area surrounding a utility penetration of a building concrete foundation slab having a pest barrier disposed intermediate the underside of the concrete foundation slab and the ground beneath the slab. The invention further has application to shielding the area around a utility penetration prior to pouring a concrete foundation, basement or crawl space slab.

Background

Various measures to prevent pests such as termites, ants and other boring insects from entering buildings or other structures, in particular residential or commercial dwellings have been proposed. One approach is to use a chemical repellent or pesticide to create a chemical barrier to entry or to pest survival in an exclusion zone. Another approach is to create a physical barrier at points of potential entry. More particularly, chemical measures include directly dispersing insecticides at places where pests inhabit, killing the pests either directly or indirectly by inducing the pests to baits, or by utilizing treated wooden materials. Additional measures for keeping pests away from wooden material portions of a building have been used including forming a barrier through dispersing pest shielding chemicals into soil in the periphery of the building or laying a pest shielding sheet on a ground surface corresponding to under floor portions of the building. Floor slab concrete may be poured above the surface of the soil on which the shielding chemicals have been dispersed or above the shielding sheet that has been laid on the soil surface for pest suppressing purposes.

With respect to either approach, chemical or physical barriers, the areas surrounding objects protruding through a slab such as utility penetrations (i.e. plumbing pipes, electrical conduit, cables, etc.) have presented special problems. Small areas

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allowing pest invasion may be created adjacent to the utility penetrations and may allow pests to enter by avoiding an otherwise continuous physical, chemical, or physical/chemical barrier.

Studies have been undertaken to look at the minimum gaps that crawling pests may enter through. Specifically some studies on termites suggest that a gap of around 1/20 inch is sufficient to prevent termite access (Ewart D.McG., M. Tamashiro, J.K. Grace & R.H. Ebesu, 1991; "Minimum foraging aperture and particle barriers for excluding the Formosan subterranean termite," Unpublished Poster, Ann. Meet. Entomol. Soc. America, Reno, Nevada). This gap is species specific and for smaller species of termites, an even smaller gap may suffice for termite entry. Regardless of the size required for entry a significantly reduced gap around penetrations will reduce the chances of termites penetrating.

Accordingly, a need exists for an improved barrier or device for preventing pest incursions at such points common in standard construction.

Summary of the Invention

The present invention provides a solution to the problem of creating an effective barrier to pest invasion around utility penetrations into foundations, footers, or walls of buildings and other structures. The invention provides means for creating a barrier around an elongated member of a utility penetration, e.g., a pipe, and optionally forming a continuous barrier with a surface such as a shielding sheet or a concrete slab.

Briefly stated, there is provided a flexible preformed barrier boot adapted for protectively sealing the area surrounding a construction utility penetration to keep pests such as termites, ants and other boring insects from entering a structure. The preformed boots may be stored in flat, folded condition prior to installation and use. In one embodiment, the boot is adapted to form a continuous barrier with a surface when installed.

In one preinstalled configuration, the barrier boot comprises:

(1) a conical body portion with a (i) a closed end formed by the apex of the conical body and (ii) an open end adapted to receive an elongated member such as a pipe.

The conical body is tapered from the open end toward the closed end so that the closed end can be cut to create an opening for passage of said elongated member inserted through the open end of the barrier boot; and

(2) a circumferential flange portion located at the open end of the body portion that is adapted to closely contact a surface when the boot is installed. The flange is adapted to directly contact surfaces such as a concrete slab or a continuous plastic sheet to further enhance the degree of boot sealing when the boot is installed on a utility penetration.

An installed configuration is achieved by opening an individual flat, folded boot and positioning it along a utility penetration in the foundation, footer or wall of a building or other structure by moving the same telescopically in a downward direction over the utility penetration and cutting the closed end to create an opening sufficient for passage of an elongated member of the utility penetration and adapted to a temporary friction retention along the utility penetration until the boot is further secured or sealed around the penetration. The circumferential flange portion of the boot is then sealed to a surface of the foundation, footer, wall, shielding sheet or vapor barrier through which the utility penetration occurs. Alternatively, the boot is positioned along a utility penetration as noted prior to pouring the concrete foundation slab and such that the circumferential flange is disposed intermediate the underside of the concrete foundation slab and the surface of the slab after the foundation is poured.

In one embodiment, barrier boot is impregnated with a pesticide such as an insecticide and/or a fungicide optionally in a controlled release fashion such as a timed release or a substantially non-release fashion (unless the integrity of the boot is compromised).

The present invention also provides another solution to the problem of creating an effective barrier to pest invasion around utility penetrations into foundations, footers, or walls of buildings and other structures prior to pouring a concrete foundation. This

aspect of the invention provides means for creating a barrier around an elongated member of a utility penetration, e.g., a pipe, and forming a continuous barrier within the concrete surface. The devices of the present invention when installed, prevent the formation of significant gaps between the device and a utility penetration, and between the device and the concrete layer. If any gaps are formed, they are small enough that the route of a crawling pest is diverted or significantly restricted and ideally completely inhibited. Specifically for termites, there should ideally be no continuous gaps through the barrier of greater than 1/16 inch and even more preferably 1/32 inch.

Brief Description of the Drawings

Figure 1 shows a partial cross-sectional view of an installation of one embodiment of the invention.

Figure 2 shows a partial cross-section view of the embodiment of the invention as shown in Figure 1 installed on a utility penetration of a concrete slab.

Figure 3 shows a cross-section view of the embodiment of the invention as shown in Figure 1.

Figure 4 shows a cross-sectional view of an alternative embodiment of the invention.

Figure 5 shows a schematic representation of a layered substructure of one embodiment of the invention. The layer at the top of the Figure represents the side of the material that is oriented toward the outside of the boot.

Figure 6 shows a top view of the embodiment of the invention for installation around a bath trap utility.

Figure 6A shows a side view of the embodiment of the invention for installation around a bath trap utility.

Figure 6B shows a cross-sectional view of the embodiment of the invention for installation around a bath trap utility.

Figure 7 shows a cut out section of an annulus representing the two-dimensional embodiment of the invention prior to installation around a utility penetration.

Figure 7A shows a front view of a two-dimensional embodiment of the invention prior to installation around a utility penetration.

Figure 8 shows a side view of an embodiment of the invention installed around a utility penetration.

Figure 8A shows a cross-sectional view of the embodiment of Figure 8 embedded in concrete.

Figure 9 shows a side view of an embodiment of the invention installed around a utility penetration.

Figure 9A shows a cross-sectional view of the embodiment of Figure 9 installed in concrete.

Figure 10 shows a top view of an embodiment of the invention where the disc portion is cut to receive the sleeve portion depicted in Figure 10A.

Figure 10A shows a top view of the sleeve portion, which combined with the part in Figure 10, forms the embodiment depicted in Figure 12.

Figure 11 shows a top view of an embodiment of the invention where the disc portion is open to receive the sleeve portion depicted in Figure 11A.

Figure 11A shows a top view of the sleeve portion with perforations to enable attachment to the disc portion of Figure 11 to form the embodiment depicted in Figure 12.

Figure 12 shows a side view of a dual sleeve/disc composite device installed around a utility penetration.

Figure 12A shows a cross-sectional view of the device of Figure 12 embedded in concrete.

Figure 13 shows a close-up view of Figure 12A.

Detailed Description of the Invention

Accordingly, in one aspect, the invention relates to a barrier boot providing protection against pest invasion. The barrier boot is particularly suited to preventing or reducing termites, ants or other boring insects from entering a building or structure in the area surrounding a utility penetration. In general, the barrier boot has a tubular portion with a first opening adapted to closely contact an elongated member passing through the tubular portion when the barrier is installed. A second opening, disposed on the opposite end of the tubular portion, is adapted to closely contact a surface such as a foundation, footer, wall, shielding sheet or vapor barrier.

In another aspect, the invention relates to a barrier boot having a conical body with a closed end formed by the apex of the conical body; and an open "bottom" end adapted to closely contact a surface when installed. The conical body is tapered from the open "bottom" end toward the closed end so that the closed end can be cut to create a "top opening for passage of an elongated member inserted through the barrier.

When installed, in addition to the close-contact, friction fit achieved by the invention around the utility penetration, the top or first opening of the barrier boot can be further secured and/or sealed around the penetration. The top or first opening of the barrier can be secured by tying, taping, the use of a pull-tie or twist tie, and/or a caulk or sealant. The caulk or sealant can include a pest repellent or pesticide.

The bottom or second opening of the barrier boot of the invention can include a circumferential flange having a first face disposed toward the top or first opening of the tubular portion (or the conical apex) and a second face disposed toward the ground or surface to be contacted. The circumferential flange may be disposed at an angle relative to a longitudinal axis of the tubular portion and/or substantially

parallel to the surface to be contacted by the second face when the boot is installed. The flange may be adapted to be sealed to the surface by a heat-seal process. Alternatively, or in addition to heat-sealing, the second face of the circumferential flange may be secured and/or sealed to the surface with an adhesive. The adhesive may include a pesticide or a pest repellent.

Heat sealing and/or adhesive may be used advantageously when the barrier boot of the invention is joined to a sheet-type pest barrier such as a woven or non-woven textile sheet, a continuous plastic or other polymeric sheet or a stainless-steel sheet. The sheet-type barrier may be specifically produced as a physical or physical/chemical pest barrier. Alternatively, the barrier of the invention may be sealed to a surface such as a concrete slab of a building foundation by installing the barrier so that the second opening and/or circumferential flange is embedded in the concrete slab.

The barrier boot is adapted for use with elongated members such as multi-sized constructions penetrations and utility installations. Such elongated members include, but are not limited to, plumbing and utility supply pipes, gas lines, electrical wiring, and conduits. Such items may be referred to generally as utility penetrations and often enter a structure through a foundation or footer. One opening of the barrier boot is designed to contact a surface of a physical or physical/chemical barrier that has been perforated by the utility penetration. A suitable surface includes horizontal preconstruction shielding sheet designed to create a continuous protective barrier in an excavation area formed after the digging work intended for the construction of a foundation and/or footer of a structure. The continuity of this surface may be compromised by the necessary utility penetrations (water, gas, electricity) and outlet ducts. The barriers of the invention facilitate the restoration of a continuous barrier in areas such as utility penetrations. Restoration of the continuity of the shielding sheet is accomplished in the area of the penetration by a close-fitting and continuously sealed barrier boot of the invention.

In some installation situations it may not be practical or desirable to pull the conical shape over the penetration. In these situations, a vertical slit may be made in the boot after the top opening has been created to allow the boot to be pulled around the

pipe. After the boot has been pulled around, the freshly created edges may be overlapped and adhered. The adhesion may be accomplished by a number of means, including heat seaming or use of an adhesive.

The barrier boots of the invention may include at least one polymeric material. The polymeric material can include at least one pesticide or a pest repellent as an active ingredient. Alternatively, the barrier boot may be made of any suitable material including a woven or non-woven textile, a polymeric or metallic material (such as stainless-steel or aluminum), and may be used in conjunction with an active pest repellent or pesticide supplied in another form. For example, a barrier boot of the invention may be used with a pellet form of a controlled release pesticide spread in the area beneath the barrier, formed by the sides of the barrier and the surface having a utility penetration. The space on the interior of the barrier may contain an active repellent or pesticide of any suitable controlled release form, including active ingredients disposed within a polymer matrix and/or associated with a suitable binder.

As a physical barrier, the invention may be formed of any suitable material as noted above, e.g., a woven or non-woven textile, a polymeric or metallic material (such as stainless-steel or aluminum). In sheet form, the material should be flexible enough to allow it to be conformed by a fastening means to the contours of a utility penetration on one end, and to a surface of another barrier, wall, or floor, on the other end.

The polymeric material that forms the barrier boot may be obtained by the extrusion of polymers, particularly polyolefins, such as polyethylene or polypropylene or polyvinyl chloride and analogous (co)polymers, the thickness of which is between 0.5 mils and 50 mils. A pesticide may be incorporated in the polymeric material during extrusion of the polymer film, the proportion being a function of the effectiveness or the active ingredient used. The production of the polymer film may be carried out starting from the polymeric material by hot extrusion-blowing or by extrusion, it being possible for either one of these extrusion methods to be followed, optionally, by hot-pressing and analogous processes known to the person skilled in the art.

As noted, the barrier boot of the invention may also be produced as a material having a pest repellent or pesticide incorporated therein. This material may be a polymeric matrix of polymer and repellent or pesticide, resulting in a controlled-release including a timed-release or a substantially non-releasing material. For example, the material may be any of the barrier materials as described in U.S. Patent No. 5,985,304, to Van Voris, et al. In granulated form, such material may also be used with an inert, physical barrier of the invention as described above.

The barrier boot of the invention may also be formed by sandwiching of a releasing/pesticide-releasing layer (releasing layer) between two substantially non-releasing layers (retaining layers). Alternately, the barrier boot may be formed using a non- or minimal-releasing layer alone. Accordingly, the barrier boot of the present invention may contain at least three layers: a releasing layer and two retaining layers. The retaining layers are disposed on either side of a releasing layer. The retaining layers allow none or only a minute amount of the active repellent or pesticide to be released through them. The barrier boot may include one or more additional layers to add strength and puncture resistance to the barrier. This additional layer or layers may be placed in any location with respect to the releasing and retaining layers, but an additional layer is preferably placed between the releasing layer and a retaining layer. The barrier boot may also be formed by sandwiching at least one pesticide releasing layer (or non- or minimal-releasing layer) with at least one pesticide retaining layer as described in WO 02/43487 A2.

In one embodiment, the above-noted releasing layer comprises a layer of a microencapsulated pesticide such as an insecticide or a fungicide. For example, the microencapsulated pesticide may be any of the microencapsulated materials as described in U.S. Patent Nos. 5,639,710; 5,725,869; 6,133,197; or 6,149,843.

The barrier boot may also include additional layers to protect the barrier from environmental factors, such as, ultraviolet rays. These additional protective layers are generally included as the outermost layers of the barrier boot. Also, these protective layers may be made of heat-sealable polymers to facilitate heat-sealability of the barrier. The thickness of these protective layers may generally be in the range from about 0.0005 inch to about 0.003 inch, preferably about 0.001 inch. The layers

of the barrier boot are held together or bonded to each other to form a unitary, multi-layer product. The layers may be bonded to each other either directly or by use of bonding layers.

The retaining layers are preferably made of a polymeric material, e.g., SARANEX, marketed by Dow Chemical Company, Midland, Michigan. The retaining layers have thickness generally in the range from about 0.001 inch to about 0.005 inches, preferably about 0.002 inches.

When intact, the retaining layer, rather than the releasing layer, controls the release of the pesticide from the barrier boot. When the retaining layers are breached, however, an effective amount of the repellent or pesticide is available to prevent pest invasion through the hole or tear. The longevity of the barrier boot, after a breach has occurred, may be increased by using a releasing layer that is a controlled (timed- or slow-release composition). The releasing layer may be made of a polymeric matrix and a pesticide that is dispersed throughout the matrix or by a microencapsulated pesticide. In one embodiment of the present invention, the polymeric matrix is made of low density polyethylene. In another embodiment, the microcapsules contain suspensions of biologically active compounds and an ultraviolet protectant.

The term "pesticide" as used herein includes insecticides and fungicides and any bioactive chemical that repels and/or prevents pests from contacting or penetrating the barrier boot. Classes of suitable active ingredients for use include pyrethroids, pyrazoles, organophosphates, phenylpyrazoles, neonicotinoids, inorganic borons, benzoylureas, amidinohydrazones, fluoroaliphatic sulfonamides, natural mectins, noviflumurons, chitin synthesis inhibitors and other known active ingredients for pest control. Suitable insecticides include, but are not limited to, imidacloprid, thiamethoxam, clothianidin, acetamiprid, fenvalerate, isofenphos, pyrethrin, pyrethroids, bifenthrin, chlorpyrifos, bendiocarb and combinations thereof. The insecticides may also include cyhalothrin, lambda-cyhalothrin, gamma-cyhalothrin, cypheonethrin, cyfluthrin, tefluthrin, cypermethrin, deltamethrin, permethrin, resmethrin, and combinations thereof. A preferred insecticide is lambda-cyhalothrin,

a highly potent termiticide with a lethal concentration to kill 99 percent of test termites (LC99) of 0.0001 $\mu\text{g}/\text{termite}$ for *Reticulitermes flavipes*, the most important U.S. termite species.

A releasing layer made of a polymeric matrix and a pesticide dispersed through the matrix, may also include carbon black. Carbon black in the form of lamp black may be used without deactivating the pesticide. The thickness of the releasing layer may generally be in the range from about 0.002 inches to about 0.005 inches, preferably about 0.0037 inches. The releasing layer releases the pesticide in a controlled manner, assisting the retaining layer in preventing loss of the pesticide from the barrier.

In addition to insecticides, fungicides may be included in the barrier. The fungicides may be included in the pesticide-releasing layer containing an insecticide or in a separate fungicide-containing layer. Fungicides can prevent deterioration of the integrity of the barrier caused by fungi. Examples of suitable fungicides include propiconazole, difenoconazole, fludioxonil, metalaxyl, mefenoxam, azoxystrobin, trifloxystrobin, furalaxyl, chlorothalonil, fenpropidin, fenpropimorph, cyprodinil, oxadixil, cyproconazole, pyriferox, fenpiclonil, penconazole, thiabendazole, pyroquilon and mixtures thereof. Fungicides that may be used also include trichloronitromethane, mixtures of methylisothiocyanate and 1,3-dichloropropane, sodium N-methyl dithiocarbonate, 2,3,5,6-tetrachloro-1,9-benzoquinone, calcium cyanamide, biphenyl, copper naphthenate, dichlophen, fentin hydroxide and combinations thereof.

Strength and puncture resistance of the barrier boot may be increased by adding a scrim layer to the polymeric sheet from which the boot is fabricated. The scrim may be made out of a woven polymer, e.g., woven polymers made of high-density polyethylene. The scrim layer may have a thickness in the range from about 0.002 inch to about 0.006 inch, or about 0.004 inch. In some circumstances, no additional strengthening of the barrier may be required, and flexibility of the barrier may be increased by excluding the scrim layer.

In another embodiment of the present invention, a solution is provided for the problem of creating an effective barrier to pest invasion around utility penetrations into foundations, footers, or walls of buildings and other structures prior to pouring a concrete foundation. The invention provides means for creating a barrier around a utility penetration, e.g., a pipe, and forming a continuous barrier within the concrete. The barrier of the invention prevents the formation of significant gaps between the device and utility penetration, and between the device and the concrete layer. If any gaps are formed, they are small enough such that the route of a crawling pest is diverted or significantly restricted; or ideally completely inhibited. For termites, there should ideally be no continuous gaps through the barrier of greater than 1/16 inch and even more preferably 1/32 inch.

When a new concrete slab is poured, it should be recognized that the concrete may form an intimate seal with the utility penetration. However this is not always the case. If the utility penetration is moved during concrete pour then a gap may be opened through the slab. Also it is common plumbing practice to put plastic sleeving or foam (for example, polyurethane) around pipes to allow for expansion and to prevent contact of copper pipes with cement. Both of these practices may lead to crawling pests-sized gaps. Also during the lifetime of the slab, it is exposed to many pressures, including expansion and contraction of the concrete, expansion and contraction of the pipes, all of which may lead to gaps opening near utility penetrations.

The descriptions in this section refer to a conduit passing through a concrete structure. A conduit is strictly a channel or pipe for conveying a fluid or for enclosing electric wires, cables, a multiple of flexible piping. While this characterizes most utility penetrations through a concrete slab, it is recognized that other penetrations pass through concrete as part of some house building practices. These may include hollow or solid stakes that act as supports for pipes and as part of the structure of the cement. This embodiment of the present invention helps protect against pests around all penetrations, therefore the following description will use the term "conduit" to include all penetrations embedded in concrete.

Conduits may enter concrete at a variety of angle, thus conduits may extend vertically through a concrete slab, however they may also come in horizontally through concrete footers. The conduits may not necessarily be at right angles to the plane of the concrete and hence pipes may enter concrete structures at a variety of angles. It should also be recognized that flexible conduits may not pass in a straight line through a concrete structure and may be curved. The invention described herein will help protect all conduits that pass through a concrete structure.

In one aspect, the device is designed in such a manner that it may be installed in pipe configurations known as bath traps wherein a region surrounding a pipe is blocked off from concrete flow during the pouring of a concrete slab by means of some continuous vertical barrier placed around the pipe such as an open cardboard box. The purpose of this configuration is to allow room for future installation of pipes needed to mate up with a bath tub or shower whose position is not accurately known at the time of concrete pour. The region of unfilled concrete may be left open, refilled with dirt or refilled later with concrete. The device is designed to accommodate vertical barriers of various shapes and sizes in situations where the bath trap void is left open or later refilled with dirt or concrete. The device consists of a barrier boot that has a tubular portion with a first opening adapted to closely contact an elongated member passing through the tubular portion when the barrier is installed. The top or first opening of the barrier boot may be further secured and/or sealed around the penetration by tying, taping, the use of a pull-tie or twist tie, and/or a caulk or sealant. The tape, caulk or sealant may include a pest repellent or pesticide. A second opening, disposed on the opposite end of the tubular portion, is adapted to closely contact a horizontal component of barrier material by means of a circumferential flange that may be sealed to the surface by a heat-seal process. Alternatively, or in addition to heat-sealing, the second face of the circumferential flange may be secured and/or sealed to the surface with tape, adhesive, caulk or sealant. The tape, adhesive, caulk or sealant may include a pesticide or a pest repellent. The horizontal component of the device consists of a section of flexible barrier film that has at its periphery an upturn, supported by a reinforcing material, that may embed in concrete during the pouring of the concrete slab. The reinforcing material may be any material that gives rigidity to the outer edge including plastic materials (polystyrene, polyester, polyethylene, PVC and many others), or metals

(stainless steel, aluminum as examples) and may be attached to the flexible barrier by a number of methods including, but not limited to, adhesives, heat seaming, sewing, rivets, sonic welding and clamps. The horizontal component contains a hole through which the penetration to be treated may pass. This hole may be located anywhere in the sheet so long as the installation of the barrier boot and application of the concrete barrier allows a gap of at least $\frac{1}{4}$ inch, or more preferably 1 inch, between any concrete barrier that may be installed and the vertical upturn in the device, in which concrete can flow. The horizontal component may be of any shape but circular, square or rectangular shapes are preferable. The size for a circular shape may be from a diameter of 1 foot to 8 feet, more preferably 3 feet. A rectangular shaped piece may be 1 square foot to 8 square feet, preferably 4 to 6 square feet. The barrier boot will usually be installed on the upwards facing side of the horizontal barrier but may be installed on the other side to accommodate configurations known as inverted bath traps where the penetration resides in a depression in the ground and may have its terminus located below the level of surrounding ground.

In another aspect, the invention relates to a barrier device providing protection against pest invasion. The barrier device is particularly suited to preventing or reducing termites, ants or other boring insects from entering a building or structure in the area surrounding various utility penetration. This barrier device is particularly suited for resisting the passage of pests into a building along a conduit set in concrete. The barrier has both a sleeve portion intimately attached to the conduit; and a means for diverting or significantly restricting travel of said pest. The barrier may be fabricated from a melt blend of thermoplastic polymers and pesticidal materials and be in various forms. As discussed above, the barrier may be formed from various layers including non-releasing layers and releasing layers.

The means for diverting the pests ideally result in the complete outer edge of the diversion being embedded into concrete to form an integral seal with the concrete slab. The extent of the embedment may vary depending on the type of conduit or the installation. The outer edge may typically be embedded by $\frac{1}{8}$ inch to 8 inches to ensure a good seal; preferably by $\frac{1}{2}$ inch to 2 inches and more preferably by approximately 1 inch.

In one form, the barrier device resembles a section of an annulus as shown in Figure 7, which may be formed into a conical shape, with a first, smaller opening adapted to closely contact an elongated member passing through the center of the cone. A second larger opening, located on the opposite end of the annulus sector, is adapted to embed into concrete. To assist with embedment, the second opening may be cuffed or inverted forming a doughnut shaped well of the material, as shown in Figure 8. The width of the well can be varied according to the needed installation characteristics. However for the product to perform optimally the distance of the outer edge of the cup from the plastic enclosed conduit should be such that concrete can flow into the cup. A distance of $\frac{1}{4}$ inch to 2 inches may be preferable, more preferably $\frac{1}{2}$ inch to 1 inch. To ensure that the outer edge of the cup remains essentially upturned and subsequently embeds into concrete, an additional reinforcing material may be attached to the broader edge of the second opening to add additional rigidity, as shown in Figure 7A. This additional material may be any material that imparts additional rigidity to the outer edge including plastic materials (polystyrene, polyester, polyethylene, PVC and many others), or metals (stainless steel, aluminium and other flexible metals, for example). This additional material or reinforcing material may be in the shape of a rigid ring that may be attached to the flexible barrier by a number of methods including, but not limited to, adhesives, heat seaming, sewing, rivets or wrapping the ring inside the flexible barrier material. This material may have many different dimensions from a wire to a small sheet of plastic. The rigidity of this reinforcing material may further be increased by attaching the material to itself where the ends meet. This may be accomplished by a number of methods including, but not limited to, staples, belt type fasteners, Velcro® fasteners, baseball cap fasteners, adhesives and other type fasteners. Alternatively, a pre-formed three-dimensional shape may be placed inside of the thus formed well to ensure the formation of a cup, such as solid circular plastic rings or metal doughnuts.

The device may be attached to the utility penetration by tying, taping, the use of a pull-tie or twist tie, and/or a caulk or sealant. The tape, caulk or sealant may include a pest repellent or pesticide. Other mechanical fasteners that may be used include,

but are not limited to, cable ties, clips, buckles, hook and loop fasteners (e.g. Velcro®), shrink film, tapes, elastomeric wrap, heat seaming or any other method of attachment.

Additionally, it has been found that the use of a fastener on the plastic sleeve intimately associated with the conduit, near the base of the cup can impart additional rigidity. This fastener may include pull-ties or twist ties.

Alternative methods of increasing the rigidity of the edge to be embedded into concrete include forming pleats or seams into the larger lower section of the annulus section shaped device once it has been wrapped around the utility penetration. These pleats or seams may optionally contain further strengthening aids including wires made from plastic or metal.

The total height of the installed device may vary depending on the size of the conduit to be protected and the additional use of the device as a protection for the conduit above the surface of the concrete. Consequently the cup embodiment may be fully embedded within the concrete or may be installed in a manner, which allows there to be a continuous sleeve of plastic around the conduit above the level of the concrete. Therefore the total height of the installed device could be from 1 inch to 10 inches. For a device to be installed in concrete from 1 inch to 3 inches and preferably 2 inches to 3 inches. For a design which is intended to be present throughout the entire depth of concrete the design may be from 3 inches to 8 inches or greater depending on thickness of the concrete.

The barrier device of the present invention may be a pre-shaped flexible sheet (Figure 7A), which is formed into a conical shape in-situ around the conduit; or as a pre-formed conical device ready to slide over a conduit and attached in a manner described above. The flexible sheet should have a method for adhesion along the long straight edge enabling the formation of the device in the field. This method of adhesion may include chemical adhesives including sealants and caulks (e.g. Weatherban® sealant tape from 3M, Tapecoat® Moldable Sealant from Titus), adhesives, glues, hot melt adhesives, tapes (e.g. Tapes based on 3M® High

Strength Acrylic Adhesive 300LSE). Alternatively, a physical adhesion method may be used, for example heat seaming or ultrasonic welding. The tape, glue or adhesive may also include a pest repellent or pesticide. The larger circumference of the blocker may then be cuffed to ensure that the edge embeds into concrete. To provide additional strength to the reinforcing aspect of this flexible design it may be desirable to attach a reinforcing material around the second larger opening, as shown in Figure 7A and as discussed above. This flexible sheet design has packaging advantages as it allows the product to be sold flat. All other design aspects of the invention including choices of material are as discussed above.

In another aspect of the invention, the barrier device shown in Figure 7A may be installed on the pipe such that the smaller opening of the device is oriented towards the ground. The thus formed cone may then be intimately attached to the pipe using suitable fasteners. At least one fastener is attached at the bottom, close to the smaller opening of the cone and at least one fastener is attached near (1 inch to 2 inches below) the larger opening of the device. This second fastener, in combination with a rigid ring along the circumference of the larger opening, forms a well which may accept concrete and thus form a complete seal, as shown in Figure 9 and 9A.

In another aspect, the barrier of the present invention has the form of a composite sleeve and disc structure. The sleeve of the device may extend to one side of the disc or to both sides of the disc. The length of this sleeve may be such that the barrier device is installed completely within the concrete structure or long enough that the sleeve extends beyond the concrete structure such that the pipe is continually encased in plastic throughout the concrete structure. Consequently the total height of combined sleeve(s) may vary from 1/16 inch to 8 inches. Preferably 1 inch to 6 inches and even more preferably 2 inches to 6 inches. The sleeve of the device is installed to closely contact the conduit while the disc is installed such that it embeds into the concrete surface. The extent to which the disc extends beyond the pipe may be adjusted to varying situations. The disc should have a diameter such that the disc embeds into concrete. In some cases this will require the disc of barrier material to extend beyond a plastic or polymeric material that is placed to protect the pipe from the concrete (for example polymeric foam materials or plastic tubes). Although the disc may be any diameter, it is usually designed to protrude a distance

of 0.5 inch to 2 inches from the pipe it is protecting and even more usually about 1 inch. Often, building practices dictate that utility penetrations can be very close together. In these instances, the disc part of the design may be altered (through the use of scissors etc.) to allow the design to be installed in close situations. The disc may be composed of one or multiple layers of the barrier film.

In one special embodiment, the disc device may have no sleeve, where the disc component alone is in intimate contact with the conduit and held by friction. This may be particularly useful in situations where the disc may be installed between sections of foam insulation.

The disc part of the device may have an optional reinforcing disc structure laminated into the disc part to impart increased rigidity to the disc. For example, in a dual sleeve composite disc, both sleeves are integrally attached to opposite sides and centrally located on respective disc faces. The two separate sleeve and disc components may then be attached to at least one reinforcing disc. The material for this lamination could include one or more layers of a range of materials including; plastic materials (polystyrene, polyester, polyolefins (polyethylene and polypropylene as examples), PVC amongst many others), metals (stainless steel, aluminium as examples). The rigid ring may be attached to the flexible barrier by a number of methods including, but not limited to, adhesives (e.g. tape, hot melts or other adhesive materials), heat seaming, sewing, rivets or wrapping the ring inside the flexible barrier material. There may also be one or multiple reinforcing rings present.

In another aspect, the device is designed in such a manner that the device may be installed in those situations where it is not practical to pull the device over the end of the conduit. In the case of the composite disc and sleeve design, the device, as shown in Figure 12, is designed with a continuous opening running parallel to the sleeves of the device and perpendicular through the disc in a continuous line. This opening allows the composite disc and sleeve device to be pulled open and wrapped around the pipe. The cut edges of the device may then be mated back together such that the product is sealed against termite entry. In one particular embodiment, the split in the disc is offset by a number of radial degrees between the bottom and top layers or halves of the disc, typically between 10 and 60 radial degrees. This

provides a flat aspect of the disc to gain further strength when the disc is placed back together as well as helping to ensure that a continual path for termites is unavailable.

In another aspect, a flap of the flexible barrier material, shaped as a segmented annulus with an outside curvature the same as the outer edge of the disc and an inner curvature the same as the inside of the disc is adhered to the disc in a position such that it overlaps the split in the disc to avoid continuous gaps. This flap of material may be present on the top of the disc, the bottom or both faces of the disc. In another aspect, the sleeves of the device have enough material to overlap one split edge of the sleeve onto the other split edge of the sleeve. This design provides a flat surface to attach one part of the barrier material to the other providing easier installation. Optionally this excess material contains a tacky adhesive, which may either serve as the final secure fastening of the sleeve to the pipe or act to hold the sleeve in place temporarily until a permanent securing system is placed.

When installed, in addition to the close-contact, friction fit achieved by the barrier around the utility penetration, the top or first opening of the barrier device may further be secured and/or sealed around the penetration. The top or first opening of the barrier may be secured by tying, taping, the use of a pull-tie or twist tie, Velcro® and/or a caulk or sealant. The tape, caulk or sealant may include a pest repellent or pesticide.

The barrier device may be adapted for use with conduits such as multi-sized constructions penetrations and utility penetrations. Such utility penetrations include, but are not limited to; plumbing and utility supply pipes, gas lines, electrical wiring, and conduits. Such items may be referred to generally as utility penetrations and often enter a structure through a foundation or footer.

As discussed above, the barrier devices of the invention may include at least one polymeric material. The polymeric material includes at least one pesticide or a pest repellent as an active ingredient. Alternatively, the flexible barrier device may be made of any suitable material including a woven or non-woven textile or a polymeric material, or a metallic material (such as stainless-steel or aluminum). In sheet form,

the material should be flexible enough to allow it to be conformed by a fastening means to contours of a utility penetration on one end, and embedded into the concrete structure on the other end.

The polymeric material that forms the barrier device may be obtained by the extrusion of polymers, particularly polyolefins, such as polyethylene or polypropylene or polyvinyl chloride and analogous (co)polymers, the thickness of which is between 0.5 mils and 50 mils. A pesticide may be incorporated in the polymeric material during extrusion of the polymer film, the proportion being a function of the effectiveness or the active ingredient used. The production of the polymer film may be carried out starting from the polymeric material by hot extrusion blowing or by extrusion; or optionally, by hot-pressing and analogous processes known to one person skilled in the art.

The advantage of using a flexible barrier material is that it gives installation advantages in installation as it allows for the devices to be manipulated to fit a multitude of materials and sizes. Often flexible materials are subject to attack by crawling pests, particularly termites and thus the combination of a flexible material in these designs along with a pesticide repellent is of particular benefit.

In another embodiment of this invention the devices described above may be prepared using a polymer blended with an insecticide material which is prepared using a manufacturing technique which melts the polymers together and incorporates the insecticide in a single step. Such a technique may be the use of injection moulding.

Referring now to the drawings, Figure 1 shows one embodiment of a substantially conical barrier boot 2 positioned on a utility penetration 8 for a building under construction. Utility penetration 8 protrudes up through the ground 18 and a termite shielding sheet barrier 16 that has been laid over the foundation area prior to pouring a concrete foundation slab. Barrier boot 2 has an opening 6 and tapers toward an apex 4. Opening 6 of barrier boot 2 is circumscribed by flange 10 having first face 12 and second face 14. In one embodiment, opening 6 has a width of from 4 to 12 inches. Second face 14 is adapted to closely contact sheet barrier 16 when

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installation of barrier boot 2 is completed around utility penetration 8. Sheet barrier 16 is disposed adjacent to ground (soil/dirt) 18 or other exterior substrate underneath or adjacent to a building structure to be completed following installation of barrier 2.

Barrier boot 2 is installed around utility penetration 8 by placing opening 6 of barrier 2 over upper end 20 of utility penetration 8 until upper end 20 is in close contact with the interior of barrier 2. At this point, barrier 2 is cut as shown by dashed line 22, and barrier 2 is pushed downward over utility penetration 8 until second face 14 of flange 10 is in close contact with sheet barrier 16. The flange 10 is then heat sealed or otherwise adhesively joined to the sheet barrier 16.

Figure 2 of the drawings shows an installed configuration of the barrier boot 2 of the present invention after a concrete foundation slab 50 has been poured. As the concrete forming the concrete foundation slab 50 cures and contracts, minute spaces 52 form between the peripheral edges of the concrete foundation slab 50 and the utility penetration 8. These small spaces provide entry points for subterranean termites to enter the building from their earthen tunnels in the ground 18 beneath the building. Since the termites can construct earthen tunnels up to the structural studs and other wood used in the framing of the building through these entry points, these entry points are critical places that require shielding.

Figure 3 shows a cross-sectional view of barrier 2 of Figure 1. Figure 4 shows an alternative embodiment of the barrier of the invention. Truncated cone 30 is similar to barrier 2 of Figures 1 and 2, except opening 32 is provided in predetermined diameters selected to provide close contact with commonly used utility penetrations.

Figure 5 shows the multilayer substructure of one embodiment of the barrier. See Example 2 below.

Figure 6 shows a barrier boot that has a tubular portion with a first opening 80 adapted to closely contact a conduit 81 passing through the tubular portion when the barrier is installed. The top or first opening of the barrier boot may be secured by a pull-tie or twist tie 82 as shown in Figure 6A. A second opening, disposed on the opposite end of the tubular portion, is adapted to closely contact a horizontal

component of barrier material by means of a circumferential flange that can be sealed to the surface by a heat-seal process. The horizontal component of the device consists of a section of flexible barrier film that has at its periphery an upturn 83, supported by a reinforcing material 84 as shown in Figure 6B. The horizontal component with reinforcing material allows the device to embed in concrete during the pouring of the concrete slab.

Figure 7 shows a cut out section of an annulus representing the flexible sheet embodiment of the invention. Figure 7A shows a front view of the flexible sheet embodiment of the invention prior to installation around a utility penetration. The flexible sheet has a method for adhesion 90 along the long straight edge enabling formation of the device in the field; and an additional reinforcing material 91 attached to the edge of the second opening to add additional rigidity once the device is formed.

Figure 8 shows a side view of an embodiment of the invention installed around a utility penetration. The top end of the sleeve portion is attached using a cable tie 100, and to assist with the embedment in concrete, the second opening is inverted and cuffed to form a doughnut shaped well 101 of the material. Figure 8A shows the device embedded in concrete such that the outer edge of the cup is a certain distance away from the conduit such that concrete flows into the cup.

Figure 9 shows a side view of an embodiment of the invention as shown in Figure 7A installed around a utility penetration such that the smaller opening of the device is orientated towards the ground. The thus formed cone is intimately attached to the pipe using suitable fasteners, and at least one fastener is attached at the bottom 110, close to the smaller opening of the cone and at least one fastener 111 is attached near the larger opening of the device. This second fastener, in combination with a rigid ring along the circumference of the larger opening, forms a well 112 which can accept concrete and thus form a complete seal and is embedded in concrete as shown in Figure 9A.

Figure 10 shows a top view of an embodiment of the invention where the disc portion has an opening with pre-cut slits 120 in the center of the disc to receive the sleeve portion 121 depicted in Figure 10A. Figure 10A shows a top view of the sleeve portion which is wrapped to form the device depicted in Figure 12.

Figure 11 shows a top view of an embodiment of the invention where the disc portion has an opening 130 to receive the sleeve portion depicted in Figure 11A. Figure 11A shows a top view of the sleeve portion with perforations 131 to enable attachment to the disc portion of Figure 11 to form the embodiment depicted in Figure 12.

Figure 12 shows a side view of a dual sleeve/disc composite device installed around a utility penetration. The top or first opening of the barrier disc device is secured around the penetration using a cable tie 140. Optionally, the bottom sleeve is secured in the same manner. The disc part of the device has an optional reinforcing disc structure 141 laminated into the disc part to impart increased rigidity to the disc. Figure 12A shows a cross-sectional view of the device of Figure 12 embedded in concrete.

Figure 13 shows a close-up view of Figure 12A where the device is embedded in concrete such if any gaps 150 are formed, there are no continuous gaps between the barrier and the conduit greater than 1/16 inch.

EXAMPLES

The following examples are provided as illustrative embodiments of the invention, and are not intended to be limiting of the scope of the invention in any way.

Example 1 Installation of a Cut-to-Fit Conical Barrier

A conical barrier having, initially, a single opening bordered by a flange adapted for heat-sealing to a sheet-type barrier is used. The body of the barrier boot is formed from a material including an active layer of a polymer matrix and a pesticide such as lambda-cyhalothrin dispersed through the matrix and a binder such as carbon black. This active layer is sandwiched between two layers of SARANEX (The Dow Chemical Company, Midland, MI). This arrangement prevents any substantial loss

of the lambda-cyhalothrin until the outer SARANEX is breached. The pesticide is then available in an effective amount in the area of the breach, such that entry of pests via the breach is prevented.

Prior to installation of the barrier, the construction site is prepared for the installation of a foundation and utility penetrations are in place. Next, a sheet barrier is installed over the entire area including the utility penetrations, using cross-shaped incisions in the sheet barrier.

The conical barrier is placed atop the end of an elongated member of the utility penetration, such as a pipe. The end of the pipe is inserted through the opening and the conical body is placed over the pipe end until the pipe end is firmly in contact with the interior of the barrier in the direction of the apex of the cone. At this point, the end of the pipe may be ascertained from the exterior of the conical barrier, by touch or by visual inspection. The excess portion of the conical body, from an area just beyond the pipe end to the conical apex, is then trimmed away to create an opening, which will allow the passage of the pipe end. The newly created opening closely contacts the outer surface of the pipe.

The conical barrier is slid along the pipe in the direction of the sheet barrier until the outward face of the flange surface contacts the sheet barrier. While the flange is firmly in contact with the sheet barrier, the materials are subjected to a heat-seal process in a known manner.

Example 2 Multilayer Barrier Boot

The barrier boot substructure can be produced as a multilayer, substantially non-releasing material. The layered structure can be produced as an extruded and laminated polyolefin film. The active ingredient, lambda-cyhalothrin, is incorporated into a centrally disposed layer that is sandwiched between layers of SARANEX film (Dow Chemical Company, Midland, MI). A layer of woven, high density polyethylene (scrim) is included to provide additional strength and durability. The outermost layers are selected to provide protection from deterioration due to UV exposure and to provide improved heat-sealing capability. As illustrated in Figure 5, the material is produced as an eight-layer product as follows:

Layer 1 - New Generation Resin (NGR) (Fabrene, Inc.) layer 60, composed of black resin (No. 20413-19, Colortech Inc.), extrusion coating grade polyolefin plastomer (Affinity PT1450, Dow Plastics), and low-density polyethylene (LC-0552-A, Nova Chemical Co., Calgary, Alberta, Canada), having a thickness of about 0.001 inch;

Layer 2 - SARANEX® 14 (Dow Chemical Company) layer 62, composed of vinylidene chloride/vinyl chloride copolymer, low-density polyethylene, ethylene vinyl acetate copolymer, and silicon dioxide, having a thickness of about 0.002 inch;

Layer 3 - NGR layer 64, as described above;

Layer 4 - Scrim (Fabrene Inc.) layer 66, composed of high-density polyethylene (Sclair HDPE No. 99G, Nova Chemical Co.) and black resin (Plasblack PE1371, Cabot Corp.), having a thickness of about 0.004 inch;

Layer 5 - LDPE, Low density polyethylene (LC-0522-A, Nova Chemical Co.) tie layer 68, containing black resin (No. 2013-19, Colortech Inc.), having a thickness of about 0.001 inch;

Layer 6 - Active ingredient layer 70, composed of gas black carbon (Colour Black FW200, Degussa Corp.), lambda-cyhalothrin, and low-density polyethylene (PE XU59400, Dow Plastics), having a thickness of about 0.002 inch;

Layer 7 - SARANEX® 14 layer 72, as described above; and

Layer 8 - NGR layer 74, as described above.

A sheet is initially formed by bonding a layer of NGR (layer 1) to a sheet of SARANEX® 14 (layer 2) using an extrusion coating method to form layer 1-2 composite. A layer of LDPE (layer 3) is melt-extruded to bond the layers 1-2 composite to a sheet of Scrim (layer 4) to form a 1-2-3 layer composite. Another layer of low density polyethylene (layer 5) is applied to the layers 1-2-3 composite by

an extrusion coating method to form the first outer layer. A layer 7-8 composite is prepared by applying a layer of NGR (layer 8) to a sheet of SARANEX® 14 layer (layer 7) by extrusion coating.

The active layer is prepared by making a premix in which is subsequently used in preparation of the active layer. A low-density polyethylene (PE XU59400, Dow Plastics) is cryogenically ground to form particles having about 35 mesh particle size. The polyethylene particles are then blended with the lampblack carbon (Lampblack Superfine NO. 6, General Carbon Company or Color Black FW200, Degussa Corp.) in a Marion-type paddle until the carbon is dispersed throughout the polyethylene forming a homogeneous mixture having a dry, flowable consistency. With the blender operating at an internal bulk temperature of about 50° C, lambda-cyhalothrin (Syngenta Crop Protection, Inc.) is added to the mixture in a molten spray. The blender agitation is maintained following the application of lambda-cyhalothrin to achieve a homogeneous mixture. The premix contains about 7.9% by weight of gas black carbon, 9.5% by weight of lambda-cyhalothrin and the balance being a low density polyethylene.

The premix is formed into active ingredient pellets by creating a strand by melt-extrusion and cutting into pellets. The active ingredient pellets are blended with low density polyethylene pellets (PE XU 59400, Dow Plastics) in a ratio of about 2:1 so as to achieve a concentration of about 6% weight percent of lambda-cyhalothrin in the pellet mixture. The pellet mixture is fed into an extruder to melt-extrude bond the first outer layer and second outer layer.

A multilayer, laminate sheet having an overall thickness of about 0.014 inch is formed. The concentration of lambda-cyhalothrin in the formed laminated sheet is about 0.9% weight percent

Example 3

The body of the barrier device was formed from a material including an active layer of a polymer matrix and a pesticide such as lambda-cyhalothrin dispersed through the matrix and a binder such as carbon black. This active layer was sandwiched

between two layers of SARANEX (The Dow Chemical Company, Midland, MI). This arrangement prevents any substantial loss of the lambda-cyhalothrin until the outer SARANEX is breached. The pesticide may then be available in an effective amount in the area of the breach, such that entry of pests via the breach would be prevented.

Prior to installation of the barrier, the construction site was prepared for the installation of a foundation and utility penetrations were in place. The conical barrier, with inverted outer edge was placed atop the end of an elongated member of the utility penetration, such as a pipe and pulled down over the pipe. The smaller opening closely contacted the outer surface of the pipe.

The conical barrier was slid along the pipe in the direction of the ground until the bottom of the device contacted the soil. The cone was then cable tied twice at the top of the cone and once near the base of the cone.

Example 4: Preparation of a disc to fit a $\frac{3}{4}$ inch pipe

The disc of flexible barrier material described in Example 3, with an outer diameter of 2.915 inches (Figure 10) was placed over a short segment of metal pipe of similar outer diameter to $\frac{3}{4}$ inch copper pipe (0.875 inch) by sliding the pipe through the pre-cut slits in the center of the disc. The slits extended radially from the center with a radius of about 0.437 inch, or half of the outer diameter of the copper pipe. The disc was pulled down the pipe until the ends of the triangular fingers from the center cut are flush with the pipe end. The sleeve of length 3.25 inches and width 1.25 inches (Figure 10A) was wrapped once around the triangular fingers and held in place with a short section of plastic pipe of larger diameter than the metal pipe and having a slit running down its length. Excess sleeve material protruded through the slit to prevent it from sealing to the rest of the sleeve and creating an opening. The sleeve was heat sealed to the fingers either by heating the pipe with a heat gun or by using an ultrasonic welder, forming a "top hat" shape. The pipe and the plastic pipe retainer are removed. A polystyrene reinforcing disc with an outer diameter of 2.915 inches and inner diameter of 0.915 inch was coated on one side with double sided adhesive tape and pressed to the bottom of the top hat portion after removing the backing paper, keeping the hole aligned with that in the top hat portion. A slit was cut into the disc part of the top hat, extending radially from the center circle to the outer circle

and in line with the opening left in the sleeve. This was repeated for another top hat portion except that the reinforcing disc had double-sided adhesive tape applied to both sides. The two top hat portions are joined by first removing all the backing paper from this top hat portion except for a small sector shaped portion with an outer arc length of about one inch, extending from the slit. A knife was used to gently score the paper here so that a sector shaped portion of paper remains after peeling off the rest.

The disc parts of the two top hats were pressed together after rotating one portion relative to the other to slightly offset the two slits, keeping the center holes aligned. The slit from the top hat portion without the sector shaped piece of backing paper lined up with the inside edge of the backing paper sector on the other top hat piece. A small strip of double sided adhesive with release liner was applied to the inside edge of the sleeve flap that extends past the slit. This is done for both sleeve flaps.

Example 5: Alternate preparation of a disc to fit a $\frac{3}{4}$ inch pipe

A sleeve of length 3.25 inches and width 1.25 inches (without tabs) with finger tabs of $\frac{1}{4}$ inch in length (Figure 11A) was wrapped around a small section of pipe of similar outer diameter to $\frac{3}{4}$ inch copper pipe (0.875 inch) with the slit fingers extending just past the edge of the pipe. A disc of the flexible barrier material with an inner diameter of 0.915 inch and outer diameter of 2.915 inches (Figure 11) was attached to a polystyrene reinforcing disc of same dimensions via double-sided adhesive tape which was applied to both sides of the reinforcing disc. This disc was slid over the pipe and sleeve with the remaining adhesive-backed side facing the slit fingers and positioned so that the fingers extend past the disc. The fingers were pressed down against the adhesive side after the backing paper was removed, forming a top hat shape. Alternatively, the double-sided adhesive tape was applied to the disc of flexible barrier material directly and the fingers pressed down against the material, then the reinforcing disc was pressed down over the fingers to form the top hat shape. A slit was cut into the disc part of the top hat, extending radially from the inner circle to the outer circle and in line with the opening left in the sleeve. This process was repeated to form a second top hat piece. A small sector shaped piece of backing paper with an outer arc length of about one inch was placed on one of the discs mask off a sector of the disc adhesive immediately adjacent to the slit in the

disc. The disc parts of the two top hats were pressed together after rotating one portion relative to the other to offset the two slits slightly. The slit from the top hat portion without the sector shaped piece of backing paper lined up with the inside edge of the backing paper sector on the other top hat piece. Should the backing paper stick to the remaining adhesive on the other disc, a small sector shaped portion of adhesive may need to be removed, or an additional piece of backing paper may be added to the other disc to protect the adhesive. A small strip of double sided adhesive was applied to the inside edge of the sleeve flap that extends past the slit. This was done for both sleeve flaps.

Example 6: Installation of a disc device on a ¾ inch copper pipe

The utility penetration was prepared by repositioning or temporarily removing any protective material covering the pipe so that the disc device can be installed close to the soil surface, allowing intimate contact between the disc device and the pipe. A disc device intended for ¾ inch copper pipes was selected. The adhesive release liners were pulled off the adhesive tabs: one sector shaped piece from the disc portion, and one from each of the sleeve tabs. The disc device was opened by grasping the device on either side of the slit region and pulling it open. The disc device was wrapped around the ¾" copper pipe and the disc portion was adhered by pulling the disc together taut and pressing down on the overlapping region to adhere it. The sleeves were pulled taut, wrapped around the pipe and adhered. A cable tie was installed around the upper sleeve and one installed around the lower sleeve and fastened securely. Any protective material around the pipe that was removed was replaced above and below the device.

Example 7: Installation of inverted cone from flat sheet

The utility penetration was prepared by repositioning or temporarily removing any protective material covering the pipe so that the device could be installed at or close to the soil surface, allowing intimate contact between the cone device and the pipe.

STEP 1: The correct size device was selected to fit the size of the utility penetration being treated.

STEP 2: The release liner from the adhesive that was applied along the entire height of the cone (Figure 7A) was removed. The flat sheet was wrapped around the utility penetration forming an inverted cone, with the smaller opening pointing down. The opposite edge of the cone was lined up and the two edges adhered with a 1/2 inch overlap, keeping the seal around the bottom as tight as possible, forming a sleeve portion of the device. A uniform seal of adhesive was used to ensure a tight seam. The overlapping edges of the stiffening material (Figure 7A) were fastened together for added strength using staples or other fastening devices/materials.

The device was slid down the utility penetration so that the lower portion of the device was sitting on or just above the soil surface.

STEP 3: The inverted cone was fastened into position using two plastic cable ties as a cable tie-fastening unit. Once the device was in position, one cable tie was installed on the lower portion of the inverted cone and another 1 inch below the ring insert. This forms the "inverted cone" as shown in Figure 9. The two cable ties were arranged around the device so that the locking mechanisms of the cable ties were at opposite sides of the pipe penetration. A third cable tie may be placed between the upper and lower ties to prevent bunching of the sleeve portion.

The protective material covering the pipe will need to be replaced above and below the device so that the entire utility penetration was in the original state.

Example 8: Installation of cup from flat sheet

The utility penetration was prepared by repositioning or temporarily removing any protective material covering the pipe so that the device could be installed at or close to the soil surface, allowing intimate contact between the device and the pipe.

STEP 1: The correct size device was selected to fit the size of the utility penetration being treated.

STEP 2: The release liner was removed from the adhesive that was applied along the entire height of the cone (Figure 7A). The flat sheet was wrapped around the utility penetration forming a cone shape around the penetration, with the smaller

opening pointing up. The opposite edge of the cone was line up and the two edges adhered with a $\frac{1}{2}$ inch overlap, keeping the seal round the top as tight as possible, forming a sleeve portion of the device. A uniform seal of adhesive was made along the seam. The overlapping edges of the stiffening material (Figure 7A) were fastened together for added strength using staples or other fastening materials. The device was slid down the utility penetration so that the lower portion of the device was sitting on or just above the soil surface.

STEP 3: The cone was fastened into position using two plastic cable ties as a cable tie-fastening unit. Once the device was in position, one cable tie was installed on the upper portion of the cone and another one, 1 inch above the ring insert. (The plastic stiffening material facing away from the penetration). Opposite sides of the cone were grasped and pulled upward and inverted so that the plastic ring was now facing towards the penetration. This forms the "cup" from the flat sheet as shown in Figure 7.

The two cable ties were arranged around the device so that the locking mechanisms of the cable ties were at opposite sides of the pipe penetration. A third cable tie may be placed between the upper and lower ties to prevent bunching of the sleeve portion.

Example 9: Preparation of flat sheet for cup device for a $\frac{3}{4}$ inch copper pipe

A piece of barrier material having the shape of a section of an annulus (Figure 7) and having a top arc length of 3.249 inches (equal to the outer diameter of $\frac{3}{4}$ inch copper pipe plus $\frac{1}{2}$ inch for overlap), a bottom arc length of 9.532 inches and width of 5 inches, measured along the edge, was laid on a flat surface. A $\frac{1}{2}$ inch wide strip of high density polyethylene (or other stiff reinforcing material) of similar curvature to the bottom of the sheet was attached to the bottom curve by double-sided adhesive tape. The sheet was then flipped over and a strip of double sided adhesive tape applied to the right edge of the device, running from top to bottom, leaving the top release liner in place.

Example 10: Preparation of pre-formed cup for $\frac{3}{4}$ inch copper pipe

A piece of barrier material having the shape of a section of an annulus (Figure 7) and having a top arc length of 3.249 inches (equal to the outer diameter of $\frac{3}{4}$ inch copper pipe plus $\frac{1}{2}$ inch for overlap), a bottom arc length of 9.532 inches and a width of 5 inches, measured along the edge, is laid on a flat surface. A $\frac{1}{2}$ inch wide strip of high density polyethylene (or other stiff reinforcing material) of similar curvature to the bottom of the sheet is attached to the bottom curve by double-sided adhesive tape. The sheet is wrapped around a section of pipe of identical diameter to $\frac{3}{4}$ inch copper pipe (0.875 inch) forming a cone with the smaller opening pointing up and the reinforcing ring on the outside of the cone. The edges are evenly overlapped until snug around the top of the pipe (about $\frac{1}{2}$ inch) and heat seamed or sonically welded together. The bottom of the cone is pulled up and inverted to form a cuff about 1 inch high. The overlapping edges of the stiffening material may be fastened together for added strength using staples or other fastening mechanisms. The device is removed from the pipe and is ready for installation as a pre-formed cup.

What is Claimed is:

1. A barrier providing protection against pest invasion, the barrier comprising,

a tubular portion having a first opening adapted to closely contact an elongated member passing through the tubular portion when it is installed and a second opening adapted to closely contact a surface.
2. A barrier of claim 1, wherein the barrier is substantially conical and is tapered in the direction from the second opening toward the first opening, such that the first opening is adapted to closely contact an elongated member inserted therethrough, and the second opening is adapted to closely contact a surface.
3. A barrier of claim 1, wherein the second opening comprises a circumferential flange having a first face directed toward the first opening of the tubular portion and a second face directed toward the surface.
4. A barrier of claim 3, wherein the circumferential flange is disposed at substantially a right angle relative to a longitudinal axis of the tubular portion.
5. A barrier of claim 3, wherein the second face of the circumferential flange comprises an adhesive.
6. A barrier of claim 3, wherein the second face of the circumferential flange is adapted to be heat sealed to the surface.
7. A barrier of claim 1, wherein the barrier comprises at least one polymeric material.
8. A barrier of claim 1, wherein the barrier is constructed of material that is flexible, thereby allowing the barrier to be stored or transported in a compact, flat condition.

9. A preformed barrier providing protection against pest invasion, the barrier comprising, a conical body having a closed end formed by the apex of the conical body; and an open end adapted to closely contact a surface when installed,

wherein the conical body is tapered from the open end toward the closed end so that the closed end is adapted to be cut to create an opening for passage of an elongated member inserted therethrough to allow the installation of the barrier.

10. A barrier of claim 9, wherein the open end comprises a circumferential flange having a first face directed toward the apex of the conical body and a second face directed toward the surface.

11. A barrier of claim 10, wherein the circumferential flange is disposed at substantially a right angle relative to a longitudinal axis of the conical body.

12. A barrier of claim 10, wherein the second face of the circumferential flange comprises an adhesive.

13. A barrier of claim 10, wherein the second face of the circumferential flange is adapted to be heat sealed to the surface.

14. A barrier of claim 9, wherein the barrier comprises at least one polymeric material.

15. A barrier of claim 9, wherein the barrier is constructed of material that is flexible, thereby allowing the barrier to be stored or transported in a compact, flat condition.

16. A barrier providing protection against pest invasion, the barrier comprising,

a tubular portion having a first opening adapted to closely contact an elongated member passing through the tubular portion when it is installed and a second opening adapted to closely contact a surface,

wherein the barrier further comprises at least one active ingredient that is a pesticide or a pest repellent.

17. A barrier of claim 16, wherein the active ingredient is provided in a controlled release composition.

18. A barrier of claim 17, wherein the controlled release composition comprises a polymer.

19. A barrier of claim 17, wherein the controlled release composition comprises carbon black.

20. A barrier of claim 16, wherein the barrier comprises at least one active ingredient layer and at least one layer that is substantially impermeable to the active ingredient.

21. A barrier of claim 16, wherein the barrier comprises at least three layers, including a layer comprising the active ingredient disposed between two layers that are substantially impermeable to the active ingredient.

22. A barrier of claim 16, wherein the barrier is constructed of material that is flexible, thereby allowing the barrier to be stored or transported in a compact, flat condition.

23. A barrier providing protection against pest invasion, the barrier comprising,

a conical body having a closed end formed by the apex of the conical body; and

an open end adapted to closely contact a surface when installed,

wherein the conical body is tapered from the open end toward the closed end so that the closed end is adapted to be cut to create an opening for passage of an elongated member inserted therethrough to allow the installation of the barrier, and wherein the barrier further comprises at least one active ingredient which is a pesticide or a pest repellent.
24. A barrier of claim 23, wherein the active ingredient is provided in a controlled release composition.
25. A barrier of claim 24, wherein the controlled release composition comprises a polymer.
26. A barrier of claim 24, wherein the controlled release composition comprises carbon black.
27. A barrier of claim 23, wherein the barrier comprises at least one active ingredient layer and at least one layer that is substantially impermeable to the active ingredient.
28. A barrier of claim 23, wherein the barrier comprises at least three layers, wherein a layer comprising the active ingredient is disposed between two layers that are substantially impermeable to the active ingredient.
29. A barrier of claim 23, wherein the barrier is constructed of material that is flexible, thereby allowing the barrier to be stored or transported in a compact, flat condition.

30. A method of creating a barrier which provides protection against pest invasion, comprising placing a sheet of material around an elongated member passing through a surface such that the sheet material forms a substantially continuous barrier in close contact with a continuous perimeter of a cross-section of the elongated member and with the surface.

31. A barrier for resisting the passage of pests into a building along a penetration set in concrete, said barrier comprising:

- I. a sleeve portion intimately attached to said penetration; and
- II. a means for diverting or significantly restricting travel of said pest.

32. The barrier of claim 31 wherein the barrier is fabricated from a melt blend of thermoplastic polymers and pesticidal materials.

33. The barrier of claim 31 wherein the barrier is fabricated from i) flexible sheets of thermoplastic polymers and pesticidal material; ii) flexible reinforcing polymeric materials; and iii) adhesive materials.

34. The barrier of claim 33 wherein the flexible sheets comprise at least one releasing layer and at least one non-releasing layer.

35. The barrier of claim 31 wherein said sleeve portion is intimately attached to said penetration such that no continuous gap exist greater than 1/16 of an inch.

36. The barrier of claim 31 wherein said means for diverting travel is at least one disc structure.

37. The barrier of claim 31 wherein said sleeve and means for diverting travel are in the form of a dual sleeve composite disc, with both sleeves integrally attached to opposite sides and centrally located on respective disc faces; said dual sleeves and disc being attached to a flexible reinforcing polymeric material, and attached to each other.

38. The barrier of claim 36 or 37 attached to a conduit.

39. The barrier of claim 36 or 37 embedded in concrete.
40. The barrier of claim 31 wherein said sleeve portion and means for diverting travel is formed from a flexible sheet in the shape of a section of an annulus, having reinforcing polymeric material along the broader edge and a means for attaching the vertical edge to itself.
41. The barrier of claim 40 wherein said barrier is wrapped around and fastened to a penetration so as to form a sleeve and an inverted cone.
42. The barrier of claim 40 wherein said barrier is wrapped around and fastened to a penetration so as to form a sleeve and a cup.
43. The barrier of claim 41 or 42 embedded in concrete.
44. A barrier comprising a flexible sheet in the shape of a section of an annulus.
45. The barrier of claim 44 further comprising reinforcing polymeric material attached along the broader edge of said section of an annulus.
46. The barrier of claim 42 further comprising a means for attaching the vertical edges to each other.
47. A barrier comprising a dual sleeve composite disc, with both sleeves integrally attached to opposite sides and centrally located on respective disc faces; said dual sleeves and disc being attached to a flexible reinforcing polymeric material, and attached to each other; wherein said dual sleeve composite disc is split parallel to the sleeve for installation around a penetration, said split in said disc portion being offset by a number of radial degrees between said dual disc.
48. The barrier of claim 47 embedded in concrete.

49. A pre-formed conical barrier having an upper and a lower opening for passage of a penetration.
50. The pre-formed conical barrier of claim 49 formed from a sector of an annulus from a barrier material having at least one polymeric layer and pesticide.
51. The pre-formed conical barrier of claim 49 attached to a penetration.
52. The pre-formed conical barrier of claim 49 embedded in concrete.
53. A barrier providing protection against pest invasion, the barrier comprising,
- a conical body having a first opening adapted to closely contact an elongated member passing through said conical body; and
- a second opening disposed on the opposite end of said conical body;
- wherein said second opening further comprises a circumferential flange sealed to a flat surface of barrier film having an upturned reinforced periphery and a hole through which a penetration may pass.
54. A barrier of claim 53, wherein the circumferential flange is sealed to said barrier film using an adhesive.
55. A barrier of claim 53, wherein the circumferential flange is sealed to said barrier film by heat sealing.
56. A barrier of claim 53, wherein the barrier comprises at least one polymeric material.
57. A barrier of claim 53 wherein the upturned periphery is reinforced with a material selected from plastic or metal.

58. A barrier of claim 53 wherein the conical body and barrier film are formed from material comprising at least one releasing layer and one non-releasing layer.
59. A barrier of claim 53 embedded in concrete.
60. A barrier for resisting the passage of pests into a building along a penetration set in concrete, said barrier comprising a means for diverting or significantly restricting travel of said pest in the form of a disc intimately attached to said penetration.
61. A barrier of claim 60 embedded in concrete.